AI Planning
Exercise Sheet 12

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Exercise 12.1

$D_0^{bwd} := \{\gamma\}$ //per definition
$D_1^{bwd} := \{\gamma, o_1\}$ //a is precondition, b is an effect in any case
$D_2^{bwd} := \{\gamma, o_1, o_2\}$ // a is an effect in any case
$D_3^{bwd} := \{\gamma, o_1, o_2, o_3\}$ //$\neg a \wedge b$ is an effect in any case
$\delta_G^{bwd}(I') = 3$

Exercise 12.2

Definitions:
$img_o(s) = \{s' \in S \mid s \xrightarrow{o} s'\}$
$wpreimg_o(T) = \bigcup_{s \in T}\{s \in S \mid s \xrightarrow{o} s'\}$
$spreimg_o(T) = \{s \in S \mid \exists s' \in T : s \xrightarrow{o} s' \wedge img_o(s) \subseteq T\}$

The definition of a weak preimage can be reformulated as follows:
$wpreimg_o(T) = \{s \in S \mid \exists s' \in T : s \xrightarrow{o} s'\}$

Since in the given transition system an operator leads from a state in which it is applicape to *exactly one* state we can further reformulate:
$wpreimg_o(T) = \{s \in S \mid s \xrightarrow{o} s'\}$

For the strong preimage, performing the same step we get:
$spreimg_o(T) = \{s \in S \mid s \xrightarrow{o} s' \wedge img_o(s) \subseteq T\}$

Again, since there is only one state an operator can lead to from a given state, $s \xrightarrow{o} s'$ implies $img_o(s) \subseteq T$. We therefore get:

$$\begin{aligned} spreimg_o(T) &= \{s \in S \mid s \xrightarrow{o} s' \wedge \top\} \\ &= \{s \in S \mid s \xrightarrow{o} s'\} \\ &= wpreimg_o(T) \end{aligned}$$

Exercise 12.3